

Basic Gynecology

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اهداء الى

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للذين يتركون بنا أشياء سعيدة تجعلنا نبسم دائما

The external genital organs (Vulva)

Vulva is the female external genital organs & composed of the following structures:

1. Mons pubis (Mons veneris):

- Mass of fat overlies the symphysis pubis; covered by skin & hair.

✓ **NB:** Pubic hair may be:-

- Feminine with upper straight border. ▽
- Masculine with upper convex border. △

2. Labia majora:

- Two skin folds anteriorly unite with mons pubis & posteriorly unite with skin of perineum & join each other forming **posterior commissure**.
- Each labium major contains mass of fat.
- The skin is covered with hair and contains sebaceous & sweat glands.
- ✓ **NB:** Some of sweat glands are large & coiled known as apocrine glands. Their secretion gives characteristic odour.
- Each labium major has 2 surfaces:
 - **Medial:** Less pigmented & smooth.
 - **Lateral:** More pigmented & covered by hair.
- Round ligament inserted in the upper part of the labium major.

3. Labia minora (nymphae):

- Two skin folds lying within labia majora.
- Each labium minor contains loose connective tissue, devoid of fat and is very vascular. So, it becomes turgid during sexual excitement.
- Skin is non-keratinized containing sebaceous glands but no hair nor sweat glands.
- Anteriorly, each labium minor divides into 2 flaps:
 - Upper flaps unite above clitoris to form prepuce of clitoris.
 - Lower flaps unite to form frenulum of clitoris.
- Posteriorly, they unite to form sharp fold of skin called Fourchette.

Fossa navicularis is the depression between Fourchette & hymen.

4. Clitoris:

- Homologous to penis in male.
- Lies in front of symphysis pubis and attached to it by suspensory ligament.

- It is 1-2 cm in length and has :-
 - Body formed of 2 corpora cavernosa.
 - Glans formed of erectile tissue.
- The most sensitive part of vulva as it is richly supplied with nerves.
- ✓ **NB:** Clitoromegaly (clitoris index $> 35 \text{ m}^2$) enlargement of clitoris & occur in hyperandrogenism.
- ✓ **NB:** Removal of clitoris (during circumcision) → ↓ sexual desire !!

5. Vestibule:

- Area lying within labia minora.
- It receives opening of:
 1. External urethral meatus.
 2. Bartholin glands
 3. Vaginal orifice
 4. Minor vestibular glands

6. External urethral meatus:

- About 2.5 cm below clitoris.
- Length of female urethra 4 cm.
- Skene tubules (two paraurethral ducts) open in the floor of urethra 1 cm from external urethral meatus.

7. Vaginal orifice:

- Bounded by:
 - Anteriorly: External urethral meatus.
 - Posteriorly: Fourchette.
 - Laterally: Labia minora.
- In virgins, it is partially closed by hymen.

❖ Hymen:

- mucous membrane Fold, covered on both sides by St. squamous epithelium
- It has one or more openings to allow passage of menstrual blood.
- It may be
 - annular (commonest)
 - biperforate(septate)
 - imperforate (result in cryptomenorrhea)
 - Crescentic.
 - cribriform
- After first coitus, hymen is torn unless it is abnormally elastic.
- During delivery, hymen is destroyed leaving small tags of fibrous tissue (carunculae myrtiformes or hymenalis).

8. Bulbs of vestibule:

- Two elongated masses of erectile tissue; one on each side of vaginal orifice.
- Covered by bulbocavernosus muscles.

9. Bartholin glands (greater vestibular gland):

- **Single or multiple:** Two
- **Size:** Small (1 cm).
- **Shape:** Oval glands.
- **Site:** Embedded in the posterior part of vestibular bulb.
- **Structure:**
 - It is a compound racemose gland.
 - The acini are lined by columnar epithelium.
 - duct (1 inch), lined by transitional epithelium,
 - Open in the vestibule at 5 and 7 O'clock position.
- **Function:** Produces mucoid secretion in response to sexual excitement acting as a lubricant for coitus.
- Gland is not felt unless diseased & duct opening not seen unless inflamed.

Blood supply:❖ **Arterial:**

1. External pudendal artery: Branch of femoral artery.
2. Internal pudendal artery: One of the two terminal branches of internal iliac a.

❖ **Venous drainage:**

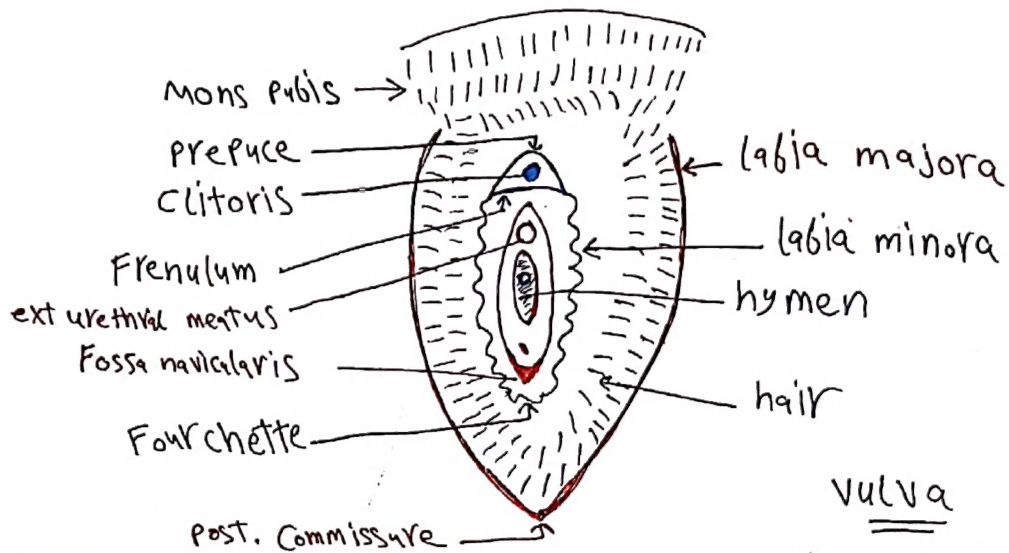
1. Accompany corresponding arteries.
2. Venous drainage of clitoris joins vaginal and vesical plexuses of veins.

Nerve supply:

1. Pudendal nerve (S2,3,4).
2. Ilio-inguinal nerve.
3. Posterior cutaneous nerve of the thigh.
4. Genital branch of genitofemoral nerve.

**Lymphatic drainage:**

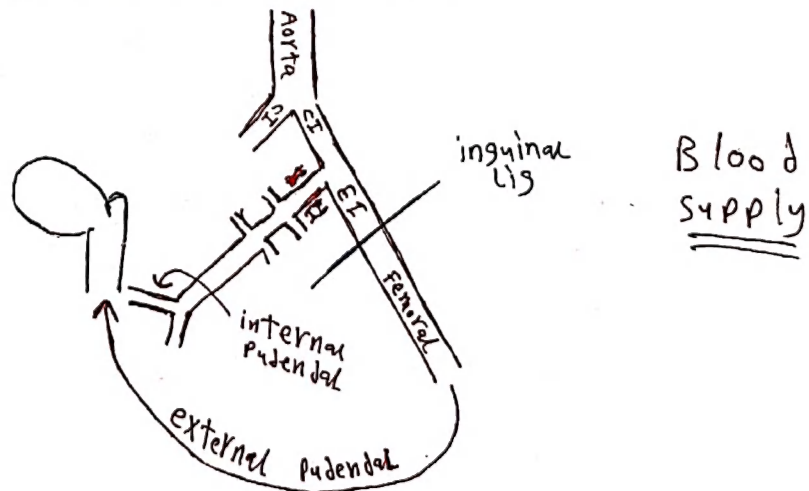
- Inguinal (superficial and deep) & femoral (superficial and deep) lymph nodes on both sides because there is crossing of lymphatics.
- Then from deep femoral lymph node (Cloquet or Rosenmuller) that present in femoral canal to external iliac LN → Common iliac LN → Para-aortic LN.
- ✓ NB: Clitoris drains directly into deep femoral LN



types of hymen



LOTfy



Perineum

❖ Anatomical (true) perineum:

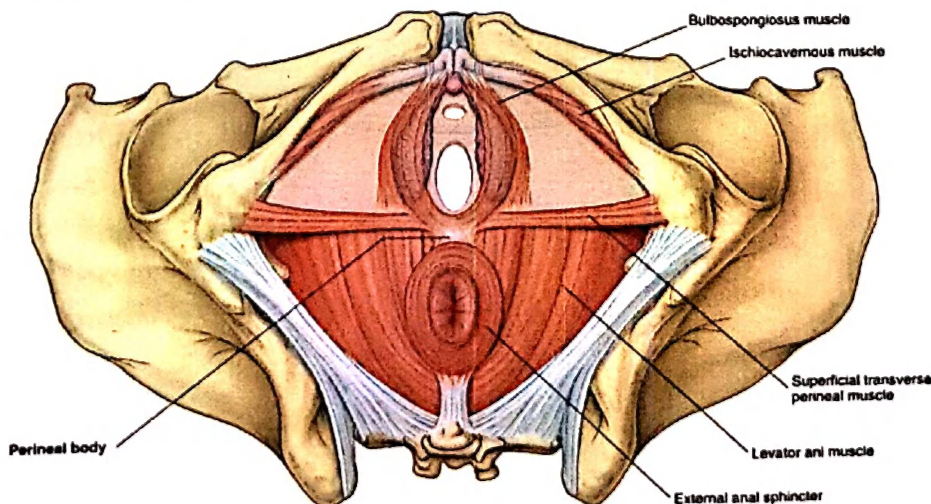
- Diamond-shaped Region which overlies pelvic outlet & divided into:
 1. **Anterior (urogenital) triangle:** Covered by the vulva and contains:
 - a. Superficial perineal pouch.
 - b. Perineal membrane.
 - c. Deep perineal pouch.
 2. **Posterior (anal) triangle:** Contains:
 - a. Anal canal surrounded by external anal sphincter.
 - b. Ischio-rectal fossa (one on each side).

❖ Gynecological perineum:

- Area between posterior commissure & anus (2.5 cm or more). It is formed of:
 - Perineal skin (less hairy).
 - Subcutaneous tissue
 - Perineal body.

Perineal body

- Fibromuscular mass that gives attachment to the following muscles:-
 1. Levator ani muscle on both sides.
 2. Superficial transverse perinii muscles.
 3. Deep transverse perinii muscles.
 4. Bulbospongiosus muscle.
 5. Part of external anal sphincter.
 6. Part of external urethral sphincter.
- Functions:
 1. Shares in support of pelvic organ.
 2. Essential for integrity of pelvic



Internal genital organs

1 - Vagina

- Fibromuscular tube extending upwards & backwards from vulva to the uterus.
- It forms an angle of 60 degrees with the horizontal plane.
- **Vaginal fornices:** Entrance of cervix into upper part of vagina divides it into:
 - Anterior fornix (shallow).
 - Posterior fornix (deep).
 - Two lateral fornices.
- **Relation:**
 1. **Anterior wall (3 inches):**
 - Upper third → pierced by the cervix.
 - Middle third → base of urinary bladder.
 - Lower third → urethra.
 2. **Posterior wall (4 inches):**
 - Upper third → covered by peritoneum of Douglas pouch.
 - Middle third → the lower third of rectum.
 - Lower third → perineal body.
 3. **Laterally:** From above downwards (artery - ligament- muscle – 4 B)
 - Crossing of **uterine artery** over ureter (2 cm lateral & above lateral fornix).
 - MacKenrodt's **ligament**.
 - Pelvic C.T
 - Levator ani **muscle**.
 - **Perineal pouch** (Deep).
 - **Bulb of vestibule**.
 - **Bulbocavernosus muscle**.
 - **Bartholin gland**.
- **Histology:**
 1. **Mucosa:**
 - Lined by stratified squamous epithelium (non-keratinized).
 - Contains glycogen that converted to lactic acid by lactobacilli.
 - Reaction of vagina acidic.
 - Estrogen stimulates deposition of glycogen into vagina.
 - Contains no glands (if present → vaginal adenosis).
 - It is kept moist by vaginal transudate and by cervical secretions.
 2. **Submucosa.**
 3. **Musculosa:** Inner circular, outer longitudinal smooth muscles.
 4. **Sheath of connective tissue.**

- **Support of vagina:**

- Upper vaginal support (level I): Paracolpium.
- Midvaginal support (level II): Endopelvic fascia.
- Distal vaginal support (level III): The strongest vaginal support. Distal third of vagina is attached directly to surrounding structure :
 1. Anterior: Fused with urethra.
 2. Posterior: Perineal body.
 3. Laterally: Pupovaginalis muscle.

- **Blood supply:**

- **Arterial:**

- | | | |
|--|---|--------------|
| 1. Vaginal artery from internal iliac. | } | Mainly |
| 2. Cervical branch of uterine artery. | | |
| 3. Middle rectal artery. | } | Additionally |
| 4. Inferior rectal artery. | | |
| 5. Internal pudendal artery. | | |

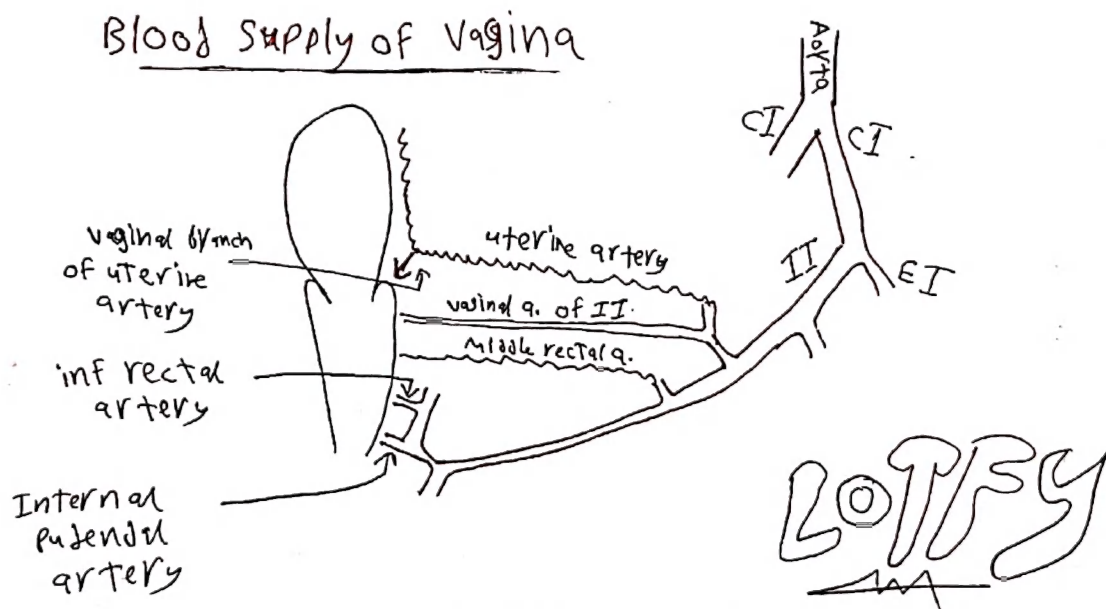
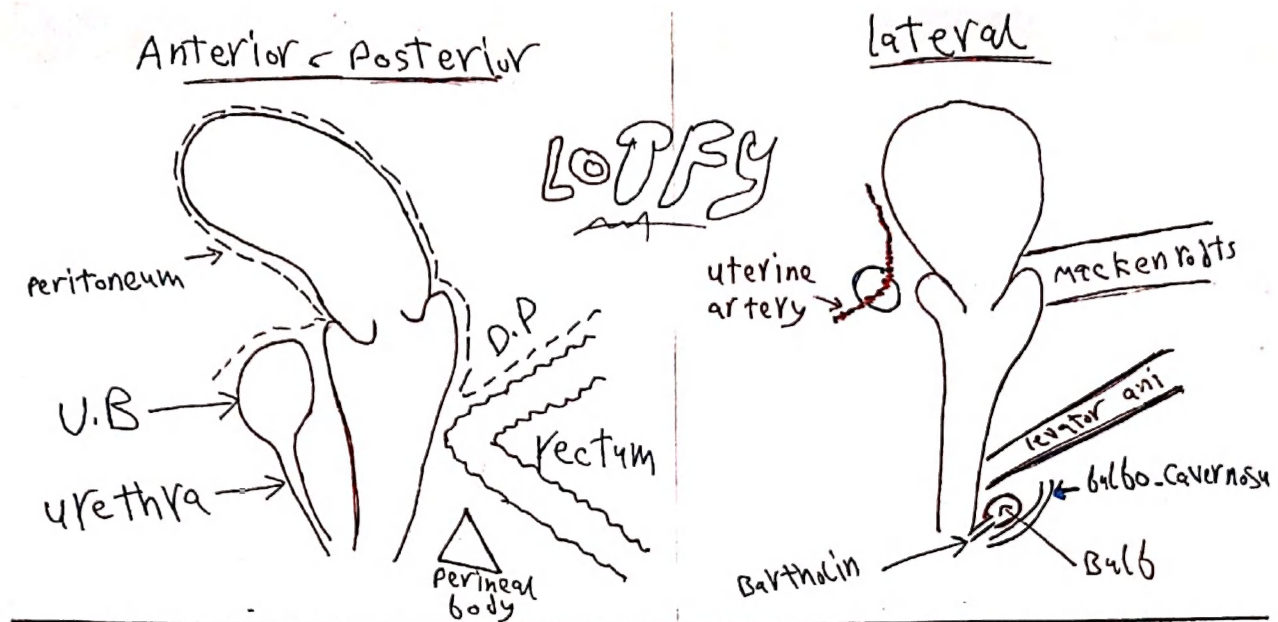
- **Venous drainage:** Vaginal venous plexus.

- **Lymphatic drainage:**

- Upper two thirds: Similar to that of uterus.
- Lower one third: Similar to that of vulva.

- **Nerve supply:**

- Upper 4/5: Autonomic (sympathetic-parasympathetic).
- Lower 1/5: Pudendal nerve (S2,3,4)



2-Uterus

- pear shaped, thick walled hollow muscular organ

- **Dimension:**

- In nullipara, 1 x 2 x 3 inches
- In multipara, 1.5 x 2.5 x 3.5 inches

- **Weight:**

- In nullipara, 50 gm
- In multipara, 70 gm

- **Parts:**

I. Body (2 inches):

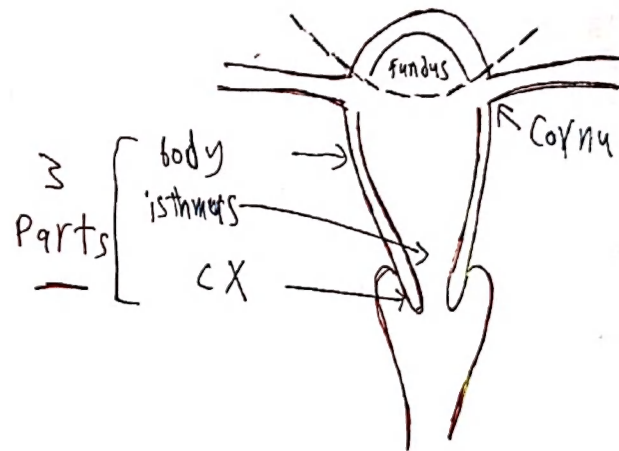
- The part above internal os.
- Cornu: area of insertion of fallopian tube, round ligament & ovarian ligament.
- Fundus is part of body above the insertion of Fallopian tube.

II. Isthmus (5 mm):

- It lies between anatomical internal os above and histological internal os (the junction of uterine mucosa and cervical mucosa) below.
- It is lined by modified endometrium with few short glands.
- During pregnancy, enlarges forming lower uterine segment (10 cm at full term).

III. Cervix (1 inch):

- Has spindle-shaped canal, which communicates above with uterine cavity & below with vagina.
- Divided by entrance of vagina into supravaginal Portion and portio-vaginalis.
- External os is rounded in nullipara & slit shaped in multipara.



NB1: Normally body: cervix

Adults	2 : 1
Adolescents	1 : 1
Infants	1 : 2

NB2:

$$\text{Uterine index} = \frac{\text{length of uterus} - \text{length of cx}}{\text{length of cx}}$$

Normal 1 or more if $< 0.75 \rightarrow$ uterine hypoplasia

- **Support of uterus:**

1. Cervical ligament.
2. Pelvic floor.
3. AVF position.

• Position of uterus:

- With bladder empty, uterus occupies a central position in pelvis & external os at the level of ischial spines.
- Normally, uterus is anteverted anteflexed (AVF):
 - **Anteverted:** Cervix makes an angle 90° with vagina.
 - **Anteflexed:** Body of uterus makes an angle 160° within cervix.
- **Causes of AVF:**
 1. Growth of posterior wall > anterior wall.
 2. Uterosacral ligament.
 3. Round ligament.
 4. Weight of abdominal organs.

✓ In 15% of normal women, uterus is retroverted or retroflexed or both (retroversion - flexion = RVF).

• Peritoneal covering:

- Body is covered by peritoneum anteriorly & posteriorly.
- From anterior surface, peritoneum is reflected on bladder dome to form uterovesical pouch.
- From posterior surface, peritoneum is reflected on rectum to form Douglas pouch or cul de sac.

• Relation:

- **Anteriorly:** Urinary bladder and uterovesical pouch.
- **Posteriorly:** Douglas pouch containing loops of intestine.
- **Laterally:** Broad ligament and its content & ureter (2 cm lateral to the cervix).

• Histology of uterus**❖ Endometrium:**

- Made of glands & stroma.
- Show cyclic changes.

❖ Myometrium: 3 layers of plain muscle fibers:

- Inner circular.
- Intermediate oblique (criss-cross) → control bleeding.
- Outer longitudinal.

❖ Perimetrium (peritoneal coat).**• Histology of cervix:****❖ Endocervix :**

- Lined by tall columnar epithelium (secrete alkaline cervical mucus).
- Below it, there is a layer of cubical (reserve) cells.
- Contains grooves & crypts located as compound racemose glands (liable to chronic inf)

❖ Muscle layer is inner circular, outer longitudinal.

❖ **Ectocervix:** Portiovaginalis is covered by stratified squamous epithelium.

✓ Junction between endocervix & ectocervix is called Transformation Zone.

• **Blood supply:**

➤ **Arterial:**

	Uterine artery	Ovarian artery
Origin:	- Anterior division of internal iliac A.	- Abd. Aorta at level of L3.
Course & relation	<ul style="list-style-type: none"> - Runs below base of broad lig. - Crosses over ureter 2cm lat. to cx. - Ascends between 2 layers of broad ligament lateral to uterus "tortuous". - Curves laterally when reach cornu. - Ends by anastomosis with ovarian a. 	<ul style="list-style-type: none"> - Descends on posterior abdominal wall. - Enters infundibulopelvic lig → broad lig → mesovarian → hilum of ovary
Branches	<ul style="list-style-type: none"> - Uterus → coronary branches that give arcuate vessels, which continue as radial branches. This radial branches end by dividing into basal and spiral arterioles. - Cervix → Circular artery & descending cervical artery. - Tube & ovary. - To ureter, bladder and vagina. 	- Gives anastomotic branches with uterine artery.

➤ **Venous drainage:**

- Pampiniform plexus of veins between 2 layers of broad ligament drain into:
 - Uterine vein → internal iliac vein.
 - Ovarian vein: right → IVC left → left renal vein.

• **Lymphatic drainage:**

- Fundus: Para-aortic lymph nodes via ovarian vessels.
- Cornu: Inguinal lymph nodes via lymphatics of round ligament.
- Middle part of uterus: Internal iliac lymph node.
- Lower part of uterus: isthmus & cervix :

1ry groups: HOPE		2ry groups:
- Internal iliac (hypogastric)	- Paracervical, parametrial	- Common iliac → para-aortic LN
- Obturator LN	- External iliac LN	- Sacral LN.

• Nerve supply

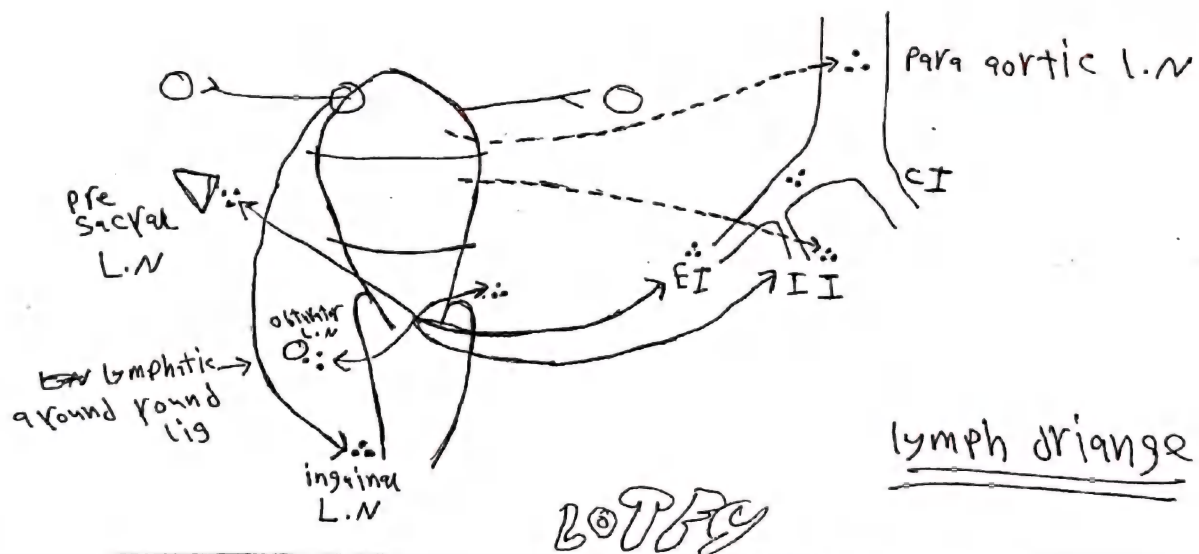
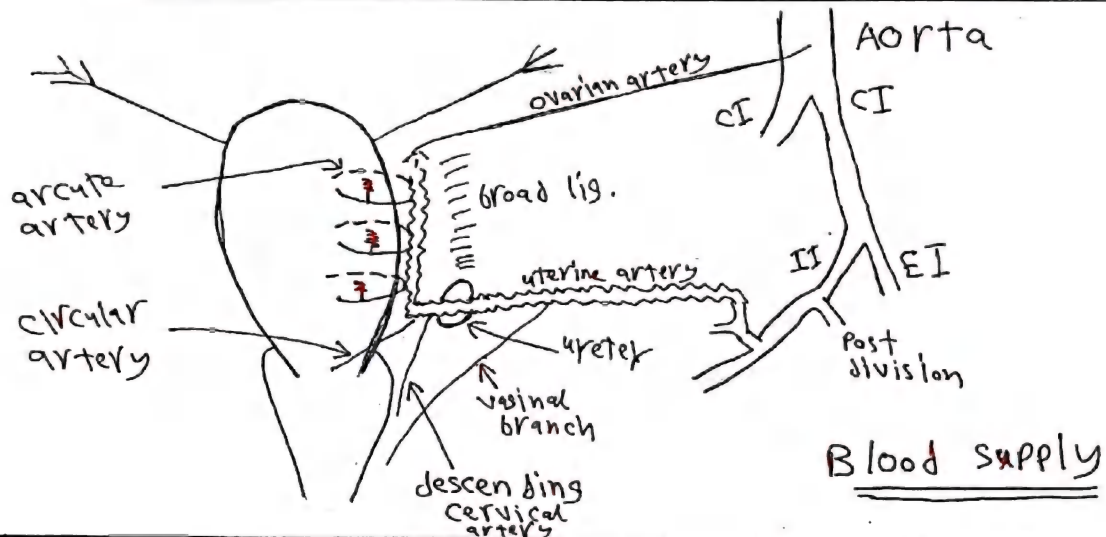
➤ Sympathetic:

- Motor: T5, 6.

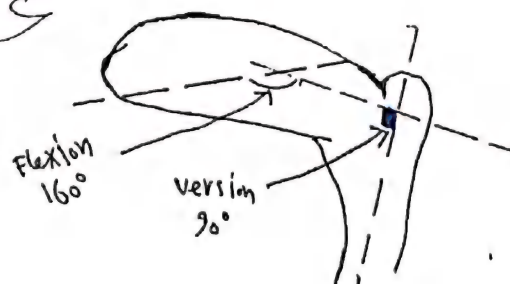
- Sensory: T10, 11, 12, L1

➤ Parasympathetic: S 2, 3, 4

✓ **NB:** Cervix is sensitive to dilatation, uterus is sensitive to distension. Both are insensitive in burn, cutting, touch and freezing.



Lotfy



position
Ante version
Ante flexion

- **Ligaments of uterus:** it can be:
 - **False ligaments** (peritoneal folds) e.g. broad ligament.
 - **True ligaments** (condensation of endopelvic fascia):
 1. Round ligament.
 2. Ovarian ligament
 3. Cervical ligaments.

Broad ligament:

- Fold of peritoneum between side of the uterus and lateral pelvic wall.
- **Parts:**
 1. Infundibulopelvic ligament: Upper lateral part of broad ligament.
 2. Mesovarium: Peritoneal fold connect ovary to posterior layer of broad lig.
 3. Mesosalpinx: The part between tube and mesovarium.
 4. Mesometrium: The remaining greater part.
- **Content:**
 1. Fallopian tube.
 2. Two ligaments (round and ovarian).
 3. Two arteries (uterine and ovarian).
 4. Two veins (uterine and ovarian).
 5. Embryological remnants (remnants of Wolffian system):
 - Epoophoron - Gartner duct. - Paroophoron. - Kobelts tubule.
 6. Parametrium (connective tissue).
 7. Nerves.
 8. Lymphatics.
 9. Venous plexus.

✓ **NB:** Ureter runs forwards & medially below root of broad ligament 2 cm lateral to cx.

Round ligaments:

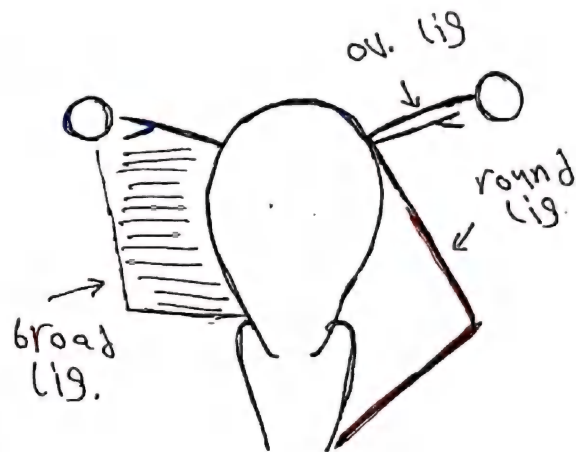
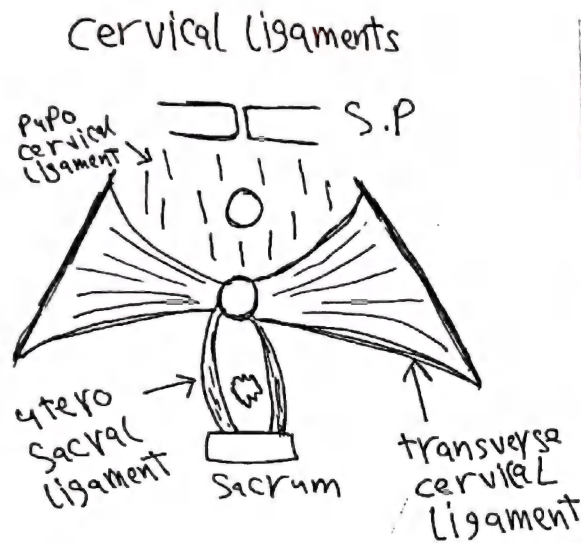
- Fibromuscular cords each attached to cornu of uterus in front of tube.
- Passes within broad ligament then through inguinal canal.
- Inserted in the upper part of labium major.
- **Arterial supply:**
 - Sampson artery (from ovarian artery).
 - Branch from inferior epigastric artery.

Ovarian ligaments:

- 2 fibromuscular cords attached to cornu of uterus behind tube and lower pole of ovary.

Cervical ligaments:

- They are condensation of endopelvic fascia including
 - A. Transverse cervical (MacKenrodt's or cardinal) lig** extends from lateral side of supravaginal cx & vaginal vault to be inserted in lateral pelvic wall. It is fan shaped.
 - B. Uterosacral ligament** extends from supravaginal cervix and vaginal vault to be inserted in third piece of sacrum.
 - C. Pubocervical ligament** extends from supravaginal cervix and vaginal vault to be inserted in the back of symphysis pubis.



Dr.lotfy

Fallopian tube

- Extends from cornu of uterus to the ovary (10 cm long).
- Runs In the free border of broad ligaments.
- **Parts:**
 - **Interstitial portion** (1 cm): The narrowest part, lies within uterine wall.
 - **Isthmus** (2-3 cm): The part immediately lateral to the uterus.
 - **Ampulla** (5 cm): The widest part.
 - **Infundibulum** (fimbriated end): has opening (abdominal ostium) which surrounded by number of finger-like processes (fimbriae) longest one is fimbria ovarica
- **Histology:**
 - **Endosalpinx:** lined by columnar epithelium (secretory cells & ciliated cells).
 - **Muscle layer:** Inner circular and outer longitudinal.
 - **Serosa:** Tube covered by peritoneum except lower border.
- **Function of tube:**
 1. Pickup ovum.
 2. Transport of ovum.
 3. Nutrition of ovum.
 4. Site of fertilization.
- **Blood supply:**
 - **Arterial:**
 1. Uterine artery.
 2. Ovarian artery.

✓ Tube has double blood supply. So, gangrene never occurs.
 - **Venous drainage:**
 1. Uterine vein
 2. Ovarian vein.
- **Lymphatic drainage:**
 - Para-aortic lymph nodes via ovarian lymphatics.
 - Most medial part → inguinal L.N via lymphatics around round ligaments.
- **Nerve supply:**
 - Sympathetic: T11-12
 - Parasympathetic.

The Ovary

- It is oval solid intraperitoneal structure.
- During reproductive years, it measures 1.5 x 2.5 x 3.5 cm.
- In nulliparous, it lies in depression on lat. pelvic wall (ovarian fossa) which bounded by
 - **In front**, obliterated umbilical artery.
 - **Behind**, ureter and internal iliac artery.
 - **The floor** of ovarian fossa is formed by :
 1. obturator internus muscle
 2. Obturator nerves
 3. Obturator vessels.
- **Relations:**
 - Upper pole: Directed upwards and attached to infundibulopelvic ligament,
 - Lower pole: Directed downwards and attached to ovarian ligament,
 - Anterior border: Attached to posterior layer of broad lig by mesovarium.
 - Posterior border: Free,
 - Medial wall: Related to intestine,
 - Lateral wall: Related to peritoneum of ovarian fossa.
- **Function:**
 - Production of ova.
 - Production of hormones (estrogen, progesterone and androgen).
- **Histology:**
 - Hilum: Area attached to mesovarium, through which blood vessels, nerves & lymphatics pass.
 - Medulla: Inner part consists of fibromuscular tissue and blood vessels.
 - Cortex: Outer part contains ovarian follicles & covered by C.T capsule (tunica albugenia). Single layer of cubical cells (germinal epithelium) covers the tunica.
- **Blood supply:**
 - Arterial:
 - Ovarian artery (from aorta just below origin of renal artery).
 - Ovarian branch of uterine artery.
 - Venous:
 - Ovarian vein (right→IVC, left → left renal vein).
 - Uterine vein → internal iliac vein.

- **Lymphatic drainage:** Para-aortic lymph nodes.
- **Nerve supply:** - Sympathetic : T10-11 - Parasympathetic: S2,3,4

✓ NB: Ovaries and fallopian tubes constitute the uterine adnexa.

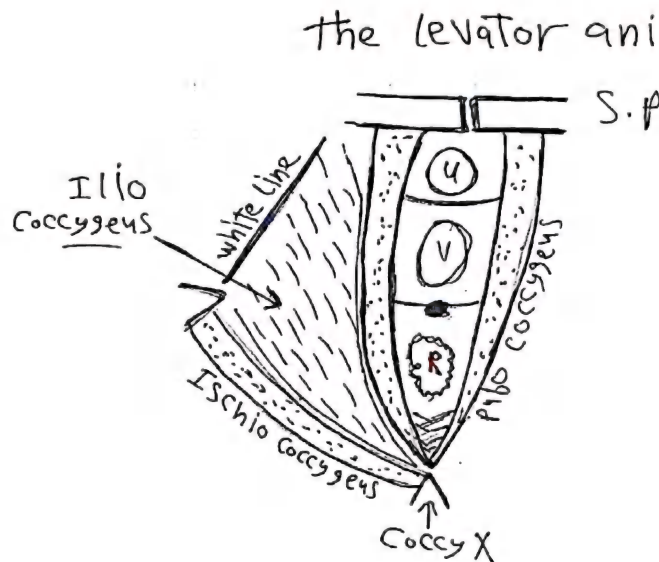
Pelvic floor

- It consists of the following structures from above downwards.
 1. **Pelvic peritoneum.**
 2. **Endopelvic fascia** which includes:
 - a. **Parietal fascia:** Obturator fascia, piriformis fascia & fascia of pelvic diaphragm.
 - b. **Visceral fascia:**
 - Encloses extra-peritoneal parts of pelvic organs.
 - Its condensation form ligaments.
 3. **Levator ani muscles** which forms pelvic diaphragm.
 4. **Perineal muscles:**
 - a. Superficial transverse perineal muscles.
 - b. Deep transverse perineal muscles.
 - c. Bulbocavernosus muscles.
 - d. Ischiocavernosus muscles.
 - e. External anal sphincter.
 5. **Subcutaneous fat and fascia.**
 6. **Perineal skin.**

Levator ani muscle

Parts	origin	insertion
Pubo -coccygeus	<ul style="list-style-type: none"> - back of body of pubic bone & meets the other in middle line - It is pierced by urethra, vagina and rectum. 	<ul style="list-style-type: none"> - Some fibers are inserted into : <ul style="list-style-type: none"> ▪ Urethra → Pubourethralis. ▪ Vagina → Pubovaginalis. ▪ Rectum → Puborectalis. - remaining fibers inserted into side of coccyx & ano-coccygeal raphe (pubococcygeus proper.) - Fibers that decussate between vagina & rectum → Fibres of Lushka. - Fibers that decussate between vagina & urethra → Fibres of Bolkagoff.

Ilio-coccygeus	- From <u>white line</u> , (thickened line on obturator fascia extend from back of pubis to ischial spine).	- Side of coccyx.
ischio -coccygeus	- From ischial spine.	- side of coccyx & last piece of sacrum



• Nerve supply:

- **Superior surface:** Perineal branch of S4.
- **Inferior surface:** Inferior rectal nerve (from pudendal nerve).

• Action:

1. Support pelvic organs (bladder, vagina, uterus and rectum).
2. Sphincteric action for urethra, vagina and rectum.
3. Responsible for internal rotation of head during labour.

✓ **NB:** Injury of this muscle predisposes to genital prolapse & stress incontinence

• Relation:

Superior surface	Inferior surface	Anterior border
<ul style="list-style-type: none"> - Covered by pelvic fascia - Related to pelvic organs (bladder, uterus and rectum). 	<ul style="list-style-type: none"> - Covered by pelvic fascia. - Related to ischiorectal fossa. 	<ul style="list-style-type: none"> - Separated by gap transmitting urethra and vagina.

Pelvic ureter

- **Length** : 12-15 cm (about the same length of abdominal ureter)
- **Diameter**: 3 mm.
- **Embryology**: It arises from ureteric bud from mesonephric duct.
- **Course & relations**:
 - It enters the pelvis by crossing the end of the common iliac artery.
 - It runs downwards anterior to internal iliac artery & behind ovarian fossa.
 - When it reaches ischial spine, it runs forwards & medially towards bladder passing in base of broad lig. in ureteric canal & below uterine artery (water under bridge).
- ✓ **NB**: In later part of its course, ureter lies 2 cm lateral to cx & 2 cm above vaginal vault
- **Blood supply**:
 - Branches from internal iliac artery, CIA or lower end of aorta.
 - It also receives branches from:
 1. Uterine artery.
 2. Vaginal artery.
 3. Middle rectal artery.
 4. Superior vesical artery.
- **Dangerous sites for ureteric injury**:
 - At pelvic inlet: During clamping of infundibulo-pelvic ligament.
 - Lateral to uterosacral ligament: During clamping of uterosacral ligament.
 - Lateral to vaginal fornices: During clamping of vaginal angle.
 - In base of broad ligament: During excision of broad ligament tumor.
 - In parametrium: During excision of parametrium.
 - Along pelvic course: During Wertheim's operation.
- **Operations associated with ureteric injury**: VAMPWr
 - Vaginal & Abdominal hysterectomy.
 - Myomectomy of cervical & broad ligament fibroid.
 - Presacral neuroectomy (LUNA).
 - Wertheim's operation.
- **Types of injury**:
 1. Complete transection.
 2. Crushing by clamp.
 3. Partial transection.
 4. Avascular necrosis.



- **Intraoperative diagnosis:**

- **Transection:** Urine in the field with urineferous odour.
- **Ligation:** Distension of ureter above site of ligation.
- ✓ This can be confirmed by ureteric catheterization. However, conditions may be passed undiagnosed.

- **Complications of untreated cases:**

1. Urinoma formation.
2. Peritonitis.
3. Renal failure.

- **Methods for protection of ureter during pelvic surgery:**

- **Preoperative:**

- **IVP:** Identify course of ureter.
- **Ureteric catheter:** Allow palpation of ureter.

- **Intraoperative:**

- Exposure of ureter at pelvic brim and its course is followed downwards (ureter is white, cord-like structure with characteristic peristaltic movement).
- Pedicles and ligaments are clamped under vision.
- Subcapsular removal of cervical fibroid.

- ✓ **NB: Branches of internal iliac artery:**

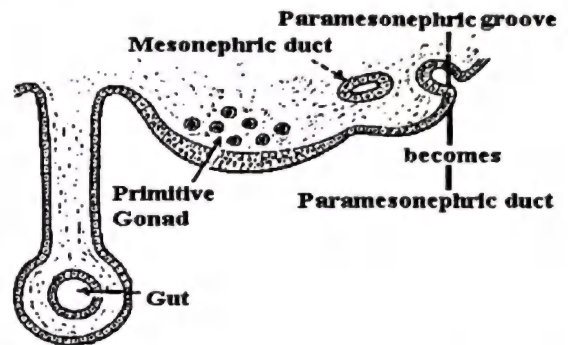
Anterior division	Posterior division
A. Visceral branches: <ol style="list-style-type: none"> 1. Uterine artery. 2. Superior vesical artery. 3. Vaginal artery (inferior vesical). 4. Middle rectal artery. B. Parietal branches: <ol style="list-style-type: none"> 1. Obturator artery. 2. Inferior gluteal artery. 3. Internal pudendal artery. 	All are parietal branches: <ol style="list-style-type: none"> 1. Ilio-lumbar artery. 2. Lateral sacral artery. 3. Superior gluteal artery.

Embryology of female genital organs

- **Development of ovary** it passes through two stages:

i. Indifferent stage :

- Extends till 7th week gestation; during which, ovary & testis are similar histologically although they are genetically determined.



1. Genital ridge: It is thickening in coelomic epithelium between dorsal mesentery & mesonephros at level of T10-11; coelomic epithelium proliferate to form sex cords
2. Genital ridge undergoes deepening till the upper ends are fused together.
3. Mesenchymal CT that gives rise to stroma, migrate from nearby mesonephros to reach the genital ridge.
4. Primitive germ cells that give rise to ova, develop in the yolk sac, then migrate to the genital ridge (3rd week gestation).
5. Primitive germ cells occupy periphery of indifferent gonads to form cortex, while center of gonads is occupied by mesenchyme & few sex cords to form medulla

ii. Differentiation of the ovary :

- After 7th week gestation.
- An incomplete fibrous capsule "tunica albugensa" separates coelomic epithelium from sex cords.
- Sex cords in medulla degenerate and replaced by CT
- Sex cords in cortex are divided by CT septa to form primary follicles.
- Each 1ry follicles consists of one primitive germ cell "oogonium" & single layer of flat cells "follicular cells".

❖ Descent of the ovary:

- The ovaries develop in the abdomen, then they descend to reach pelvis by:

A. Gubernaculum:

- Fibromuscular band extends from lower pole of ovary and labia majora.
- Contraction of gubernaculum → descent of ovary.
- Development of uterus divides gubernaculum into ovarian ligament & round lig.

B. Unequal growth of body of the fetus.

- **NB1:** Number of ova:

- At 20 w → 2-5 millions. - At birth → One million. - At puberty → 300,000.

• NB2:

- 1st meiotic division of germ cells starts at 8-12 weeks and become arrested at prophase (now, it is called 1ry oocyte).
- 1st meiotic division completed after puberty just before ovulation (2ry oocyte + 1st polar body) & enters 2nd meiotic division & becomes arrested at metaphase.
- 2nd meiotic division complete at fertilization time (mature ovum + 2nd polar body)

• Development of tubes, uterus & vagina

- A longitudinal groove from coelomic epithelium on each side lateral to mesonephric duct called **Muller's groove**.
- This groove deepens to form **Mullerian duct "paramesonephric duct"**.
- The cranial end of Mullerian duct remains open & connected to coelomic cavity (peritoneal cavity).
- The caudal end grows medially ventral to mesonephric duct to meet its fellow from opposite side.
- Then, they pass side by side to reach back of definitive uro-genital sinus.
- Now, **Mullerian duct** has 3 parts :
 - Cranial → Vertical.
 - Middle → Horizontal.
 - Caudal → Vertical.
- The 2 caudal vertical parts fuse to form a single canal called uterovaginal canal, that pushes definitive urogenital sinus to produce **Muller's tubercle**.
- The paramesonephric ducts modify to form the female genital duct.

➤ Uterine tube:

- Arises from cranial vertical part of Mullerian duct.
- Its cranial end remains communicating with peritoneal cavity.

➤ Uterus and cervix:

- arise from middle horizontal part of 2 paramesonephric ducts & cranial part of uterovaginal canal.

➤ Vagina:

1. Upper 4/5th from the caudal part of the uterovaginal canal (mesodermal).
 2. Lower 1/5th from the definitive urogenital sinus (endodermal).
 3. septum in between (Muller's tubercle) forms hymen (later on an opening develops through it)
- ✓ Canalization of vaginal plate occurs at 18 weeks.

- **Development of the vulva:**

- It starts at 7th week of gestation.
- Two folds will develop on each side of urogenital membrane :
 - Inner one → Urethral fold
 - Outer one → Genital fold
- Two genital folds fuse anteriorly to form genital tubercle. Then, differentiation occur:
 - Genital tubercle → Clitoris.
 - Two urethral folds → Labia minora.
 - Two genital folds → Labia majora.
 - urogenital sinus → Vestibule
 - urogenital sinus → Urethra
 - urogenital sinus → Bartholin gland "as an outgrowth"

- ❖ **Wolffian system in female:**

- It will undergo atrophy & form embryonic remnants between the two layers of the broad ligaments. These are: **EGPT**



1. Epoophoron: Few tubules lying between the ovary and the tube.
2. Gartner or Wolffian (mesonephric) duct: run in broad ligament parallel to tube, then to uterus, then in the antero-lateral wall of vagina.
3. Paroophoron: Tubules lying between the ovary and the uterus.
4. Kobelt tubules, which are found in the outer part of the broad ligament.

Congenital anomalies of the female genital tract

Uterus, mullerian duct abnormalitis

- Congenital anomalies result from:
 1. Defective organogenesis
 2. Defective fusion.
 3. Defective septal resorption.
- Mullerian duct anomalies are categorized into 7 classes according to the American Fertility Society (AFS) Classification as follows (1988):
 - **Class I (hypoplasia/agenesis):** Mayer-Rokitansky-Kuster-Hauser syndrome.
 - **Class II (Unicornuate uterus):**
 - Due to complete, or almost complete, arrest of development of 1 mullerian duct
 - may associated with rudimentary horn arising from contralateral mullerian duct.
 - **Class III (Dideiphs uterus):**
 - Due to complete nonfusion of both mullerian ducts
 - Full development of each mullerian duct
 - **Class IV (Bicornuate uterus):**
 - Due to partial nonfusion of the mullerian ducts,
 - Of key importance is the prominent fundal cleft (>1 cm), which distinguishes the anomaly from septate uterus.
 - **Class V (Septate uterus):**
 - Due to failure of resorption of the septum between 2 uterine horns.
 - The midline septum can be partial or complete (of variable length) and can be muscular or fibrous.
 - **Class VI (Arcuate uterus):**
 - Due to Mild thickening of the midline fundal myometrium resulting in fundal cavity indentation but normal outer fundal contour
 - Arcuate uterus has single uterine cavity with a convex or flat uterine fundus.
 - **Class VII (diethylstilbestrol-related anomaly):**
 - Diethylstilbestrol (DES), estrogen analogue prescribed to prevent miscarriage from 1945-1971.
 - Female fetuses that are affected have abnormal findings include:
 - uterine hypoplasia
 - T-shaped uterine cavity
 - vagina adenosis with ↑ risk of vaginal clear cell carcinoma.
 - cavity irregularity due to myometrial hypertrophy (pathognomonic),

- **Disorders associated with congenital abnormalities of uterus**

1. Spasmodic dysmenorrhoea occurs with hypoplastic uterus.
2. Menorrhagia may occur in bicornuate uterus due to ↑ surface area of endometrium
3. Infertility because of uterine hypoplasia.
4. Ectopic pregnancy may occur in the rudimentary horn.
5. Abortion & preterm labour because of uterine hypoplasia, congenital weakness of uterine isthmus (incompetent cervix).
6. Malpresentation as breech or transverse lie. Habitual Malpresentation suggests uterine malformation as bicornuate, septate & subseptate uterus.
7. Uterine inertia during labour due to uterine hypoplasia.
8. Obstructed labour by non-pregnant horn of bicornuate uterus or by longitudinal vaginal septum.
9. Placenta accreta when the placenta is implanted on uterine septum.

Congenital abnormalities of the ovaries:

1. Aplasia or complete absence.
2. Ovarian (gonadal) dysgenesis in the form of fibrous bands with no follicles "streak gonads" as seen in Turner syndrome.
3. Accessory ovaries.
4. Failure of descent into the pelvis.
5. Ovotestis, which is, combined ovarian & testicular tissues seen in true hermaphrodite.

Congenital abnormalities of the tubes:

1. Aplasia.
 2. Hypoplasia: the tube is long, narrow and tortuous.
 3. Accessory ostia.
 4. Congenital diverticulae.
- ✓ These anomalies predispose to tubal pregnancy.

Congenital abnormalities of the vagina:

1. Aplasia. vagina may be completely absent or is represented by a shallow depression (the part developing from the urogenital sinus).
2. Hypoplasia. The vagina is short and narrow.
3. Transverse or longitudinal septum.
4. Congenital stricture.
5. Double vagina (uterus didelphys).
6. Congenital ureterovaginal, vesicovaginal or rectovaginal fistula

Congenital abnormalities of the vulva:

1. Hypoplasia. Infantile vulva as in Turner syndrome.
2. Cysts as congenital dermoid cyst which occurs only in the midline.
3. Accessory nipple or breast. they lie in milk line which extend from axilla to vulva
4. Hypertrophy of the clitoris (clitoromegaly: clitoridal index $>35 \text{ mm}^2$) which is usually associated with other manifestations of virilism.
5. Hypertrophy of one or both labia minora (dog-ear labia minora).
6. Ambiguous external genitalia as in congenital adrenal hyperplasia.
7. Double vulva. There is duplication of the genital tract, urethra, and bladder.

Vaginal agenesis (Aplasia)

- Absence of the whole vagina.
- Absence of upper 4/5th of vagina (developed from Mullerian ducts).
- **Diagnosis:**
 - Symptoms: amenorrhea (lry).
 - Signs: Absent vagina.
 - U/S: confirm presence or absence of uterus.
 - IVP: exclude renal anomalies.
 - Testosterone level exclude testicular feminization syndrome
 - Chromosomal analysis exclude testicular feminization syndrome.
- **Treatment:**
 - If uterus is present: immediate removal of obstruction to allow menstrual flow
 - If uterus is absent: creation of new vagina.
 - Frank non operative method:
 - Repeated application of vaginal dilators for 20 minutes / day.
 - Functional vagina will be obtained after 6wk.
 - McIndoe's operation:
 - A space is dissected between bladder & rectum.
 - Split-thickness skin graft applied over a mould then inserted into pouch.
 - The mould is removed after 2-3 week.
 - After that the patient is given a new mould which is used until she starts intercourse. (The best dilator is the husband penis).
 - William's operation:
 - U-shaped incision is done over vulva & perineum.

- inner edges are at first sutured together in midline then outer edges are sutured to make a tube for intercourse.

Imperforate hymen

- It is due to failure of canalization of Mullerian duct.
- **Pathogenesis & pathology:**
 - After puberty:**
 - Blood accumulate inside vagina causing distension
 - Then haematometra → haematosalpmx.
 - In neglected cases blood pass to peritoneal cavity causing adhesions.
 - Some blood is absorbed so H blood is viscid dark brown.
- **Symptoms:**
 - 1ry amenorrhea.
 - Cyclic lower abdominal pain.
 - Abdominal swelling.
 - Urinary symptoms: dysuria, acute urine retention or difficulty in micturation due to compression of urethra by vagina.
- **Signs:**
 - **Generally:** 2ry sexual characters are well developed.
 - **Abdominal:** Pelvi-abdominal mass tense cystic limited mobility (haematocolpos) with Firm mass above (uterus).
 - **Vaginal:** bulging bluish hymen.
 - **P/R:** cystic mass in front of rectum.
- **Investigations:** **US:** haematometra, haematocolpos.
- **Treatment**
 - Under general anesthesia.
 - Complete aseptic conditions.
 - Hymenotomy: Cruciate incision (by diathermy) + trimming of edges.
 - Allow slow escape of blood.
 - Prostaglandins may be of value in some cases.
 - Antibiotics to prevent infection
 - Blood a good medium of infection.
 - Absence of lactobacilli.
 - A certificate should be given to the patient.

Physiology of menstruation

Ovarian cycle

- It starts after puberty.
- Ovary undergoes cyclic changes, which is responsible for all changes occurring in genital tract.
- It passes in the following stages:

i. Follicular phase :

1. **Primordial follicles** : is made of:

- Oocyte arrested in prophase of 1st meiotic division.
- Single layer of flat cells "granulosa cells".

2. **Spontaneous growth** of a number of follicles >100 occur

- Mechanism of initial growth unknown- **not dependant on FSH and LH**".
- This process occurs 3 cycles prior to ovulation (**Recruitment**)
- 1st sign of growth is granulosa cells become cuboidal & form multiple layers around oocyte.

3. **Pre-antral follicle**:

- oocyte expands & become surrounded by "Glycoprotein coat around oocyte & hyaline membrane" → zona pellucida
- Fluid filled spaces appear between granulosa cells.
- Granulosa cells synthesis estrogen "E2" (from androstenedione) & inhibin.

❖ **selection and dominance** :

- Only 1 follicle will continue growth while others undergo atresia by 6th d due:
 1. follicle that will become dominant contains highest number of FSH receptor
 2. ↑ Level of E2 & inhibin → -ve feedback on FSH production by pituitary ↓ relative FSH.
 3. Other follicles cannot convert androstenedione to E2 → accumulation of Androstenedione in these follicles → atresia "atretic follicles".
 4. Dominant follicle will not affected "very sensitive to FSH" & will escape atresia
 5. Inhibin is involved in the process of atresia of other follicles.

4. **Antral follicle**:

- The fluid filled spaces will coalesce & form one fluid filled space pushing oocyte with its surrounding cells to one side.
- Cells surrounding oocyte called corona radiata and cumulus oophorus.

- Ovarian stroma around growing follicle differentiate into:

Theca interna	Theca externa
<ul style="list-style-type: none"> - Large cells produce steroids. - Highly vascular. 	<ul style="list-style-type: none"> - Flat theca cells. - Less vascular.

- Now it is called mature Graffian follicle "18-24mm" which consists of:
 1. Ovum "120 um".
 2. Perivittelline space.
 3. Zona pellucida.
 4. Corona radiata.
 5. Cumulus oophorus.
 6. Granulosa cells & antrum containing fluid.
 7. Theca interna cells.
 8. Theca externa cells.

ii. Ovulation :

- It is extrusion of ovum with the surrounding layer of granulosa cells "corona radiata" from Graffian follicle into peritoneal cavity.
- It occurs 36 h from onset of LH surge & 12 h after Peak of LH surge.
- LH surge stimulates:
 1. Completion of 1st meiotic division (1st polar body + 2ry oocyte).
 2. Luteinization of granulosa cells.
 3. Formation & maintenance of corpus luteum
 4. Synthesis of progesterone & prostaglandins.

❖ Mechanism of ovulation:

- ↑ Proteolytic activity "proteases, collagenase".
- PG → ↑ s. muscles contraction around Graffian follicle → ↑ intrafollicular pressure.
- PG → ↑ follicular fluid → ↑ intrafollicular pressure.
- Progesterone released from luteinized cells → ↑ FSH surge "smaller than LH surge" → will aid process of ovulation.

iii. Luteal phase:

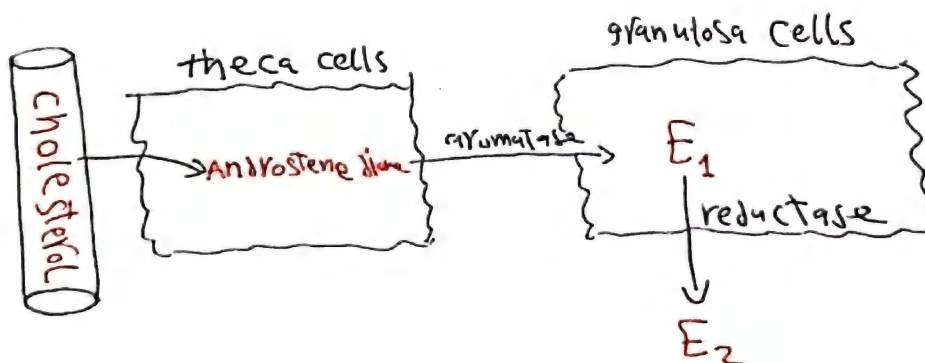
1. Granulosa → Lutein cells. Theca cells → para lutein cells. (under LH effect)
2. The follicle after ovulation is transformed into corpus luteum which is:
 - More vascular.
 - High content of "cholesterol & carotin" → yellow in color.
 - Granulosa cells & theca cells proliferate and produce P mainly and E.
3. Fate:
 - p → -ve feedback on LH release → degeneration of corpus luteum → corpus albicans → ↓ P and E level → menstruation.
 - Usually corpus luteum survives for 14 days.
4. If pregnancy occur : growing ovum → HCG → maintenance of corpus luteum → corpus luteum of pregnancy

Hormonal control of ovarian cycle

- Hypothalamus produces "GnRH" in pulsatile manner
 - Pulse frequency in 1st half of cycle "follicular phase" is every 60-90 min.
 - Pulse frequency in 2nd half of cycle "luteal phase" is every 120-180 min.
- These will reach pituitary via hypothalmo-hypophyseal portal circulation.
- Basophil cells of pituitary will release → FSH and LH
- ❖ **Hypothalamus is under control of:**
 - Cerebral cortex.
 - Emotions.
 - Diet.
 - Feedback mechanism "sex hormones"

• During follicular phase:

- Initial growth of follicles** is not dependent on gonadotrophins while if not followed by stimulation by FSH, atresia will occur.
- Low level of estrogen** in blood at the beginning of cycle stimulate pituitary to produce FSH and to lesser extent LH.
- FSH** → stimulates growth of follicles.
- Two cell theory** of steroidogenesis.



5. ↑ Estrogen production from the follicle: will lead to:

- ↑ FSH & LH synthesis but ↓ secretion → drop in FSH level → atresia of all follicles except the dominant follicle "contain ↑ FSH receptors".
- ↑ Inhibin will aid this process by inhibition of pituitary FSH not GnRh.
- Synthesis of LH receptors on granulosa cells of the dominant follicle.
- At midcycle: when E2 level is sustained (48-50 hr.) above a critical level (>200 pg/ml), it will lead to ↑ in amplitude & frequency of GnRh pulses which exert a positive feedback on LH → LH surge.
- Midcycle ↑ in P is essential to ensure sufficient LH receptors amount.

- **LH surge:**

1. Stimulate completion of 1st meiotic division & oocyte will enter 2nd meiotic division & arrest at metaphase.
2. Causes luteinization of granulosa cells → preovulatory release of small amount of P.
 - **This progesterone:**
 - facilitates the feed back of E2 on LH.
 - causes small FSH surge.
 - **FSH surge:** it cause
 - Important intrafollicular changes necessary for ovulation.
 - Production of LH receptors in sufficient number on granulosa cells.
3. Stimulates synthesis of PGE2 and F2 before ovulation.
4. Post-ovulatory maintenance of corpus luteum.

- **Luteal phase:**

- Corpus luteum produces progesterone and E2 under effect of LH:
 - ❖ **If pregnancy does not occur:**
 - ↑ Level of P and E will cause -ve feedback on hypothalamus → ↓ GnRH → ↓ LH → degeneration of corpus luteum → corpus albicans.
 - This will result in ↓ E & P level in the blood :
 - Menstruation.
 - release of pituitary from -ve feedback inhibition & new cycle start
 - ❖ **If pregnancy occurs:**
 - Growing ovum → ↑HCG "similar to LH" ⇒ maintains corpus luteum function till 10-12 w when the placenta will be formed.

Menstrual cycle

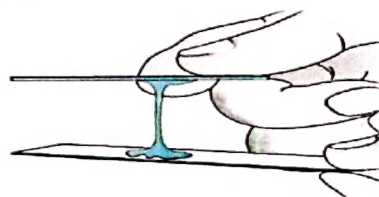
- **Menstruation:**

- Cycle uterine bleeding caused by shedding of secretory endometrium.
- Occurs between menarche (1st menstruation) & menopause (cessation of menses)
- It includes shedding of superficial & middle layer of endometrium leaving basal layer.

- **Characteristics of menstruation:**

1. **Menarche:** It is the 1st menstruation in female life "10-16 years" - 13 years
2. **Duration of bleeding:** 2- 7 days
 - If > 7 days → menorrhagia.
 - If < 2 days → hypomenorrhea
3. **Amount:** 20- 80 ml
 - If > 80 ml → menorrhagia.
 - If > 20 ml → hypomenorrhea

- NB: Estrogenic effect is maximums 24- 36h before ovulation.
- **Spinbarkiet test "Thread test"**
 - drop of mucous on tip of artery forceps & artery is opened :
 - Cervical mucous become down into thread.
 - Can be done using 2 slides.



- **Fern test:**

- A drop of mucous is left to dry on a slide and examined by microscopy :
 - arborization "NaCl / KCl crystals"
 - Palm leaf appearance.



Cyclic changes of vaginal epithelium

- Vaginal epithelium: non-keratinized stratified squamous epithelium.
- Desquamation occurs continuously

1st half of cycle	2nd half of cycle
<p>"Estrogen effect"</p> <ul style="list-style-type: none"> • E → maturation of epithelium & shedding of superficial cells in vaginal smear: <ol style="list-style-type: none"> 1. Separate. 2. Eosinophilic cytoplasm. 3. Pyknotic nucleus. 4. Clear background "few leukocytes" 	<p>"progesterone effect"</p> <ul style="list-style-type: none"> • P → cause shedding of intermediate cells in vaginal smear <ol style="list-style-type: none"> 1. Clumped together. 2. Basophilic cytoplasm. 3. Vesicular nucleus. 4. Background contain many WBCs. 5. Navicular cells "folded border"

- maturation index:
 - Parabasal / intermediate/ superficial cells.

Cyclic changes of endometrium

	Proliferative phase	Secretory phase
Duration	<ul style="list-style-type: none"> - 9-11 days - Starts after end of menses - Ends at time of ovulation. 	<ul style="list-style-type: none"> - 14 days (constant) - Starts with ovulation. - Ends with onset of menstruation.

Hormonal control	<ul style="list-style-type: none"> - E released from graffian follicle - It stimulate growth & proliferation of endometrium from basal layer. - It passes through 2 days of resting stage. 	<ul style="list-style-type: none"> - P released from corpus luteum - It produces secretory changes in estrogen primed endometrium.
Endometrial thickness	- 3-4 mm	- 6-8mm
Glands	<ul style="list-style-type: none"> - ↑ number & length - tubular and no secretion 	<ul style="list-style-type: none"> - ↑ length & become tortuous "cork screw" or saw-tooth appearance" - filled with secretions "glycogen , mucin"
Epithelium	- Low columnar	<ul style="list-style-type: none"> - high columnar with: - Sub nuclear vacules. - supra nuclear vacules
Stromal cells	- ↑ In size and become globular.	<ul style="list-style-type: none"> - ↑ in size and become polygonal - ↑ Cytoplasm.
Stroma	- Dense & formed of single layer.	<ul style="list-style-type: none"> - Edematous & PNL infiltration occur "3 days before menstruation". - Endometrium is differentiated into 3 layer: <ol style="list-style-type: none"> 1. <u>Superficial compact layer</u>: around necks of glands. Cells closely packed together. 2. <u>Middle spongy layer</u>: around distended lumen of glands. 3. <u>Deep basal layer</u>: around basal part of glands.
Vascularity	- Gradually increased	<ul style="list-style-type: none"> - Greatly ↑ & 2 types of arterioles: <ol style="list-style-type: none"> 1. <u>Basal arterioles</u>: short, straight anastomase freely to supply basal layers. 2. <u>Spiral arterioles</u>: spiral and supply superficial layer & don't anastomase (end arteries).